Space Weather Technical Forecast

Issued on Monday, 10 January 2022 at 00:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing Slight Chance of M-class flares (R1-R2 radio blackouts). Increasing Chance of Active fluence

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours, with only very minor flares. There are currently four sunspots on the visible disc. The most notable is AR2924, which has shown some decrease in magnetic complexity losing its intermediate spots and is now classified Eko/Beta. AR2926 in the northern hemisphere has decayed to plage but a NEW unnumbered region has emerged between AR2924 and 2925 The three spots are all small and simple, although AR2927 near the southeast limb is still foreshortened making classification a little uncertain. There is an area of plage which has rotated onto the northeast limb which shows a fair amount of magnetic flux, but no spots at present, and will be monitored.
No confirmed Earth-directed CMEs have been observed in currently available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, have been slightly elevated to elevated due to connection with a High Speed Stream from CH43/- . Solar wind speeds started around 470 km/s, before rising steadily to around 550 km/s at 09/0830 UTC, after which they have slowly eased back to around 450 km/s. Density was just above average for much of the period, with a peak near 17 ppcc around 09/0523 UTC, before easing back to average levels late in the period. The IMF was strong to start around 20 nT, before declining back to weak levels after 09/0700 UTC. The Bz was moderate at first, between +15/-12 nT, before becoming nearer neutral after 09/0700 UTC. Phi angle started negative (towards the Sun) before rotating into a positive orientation (away from the Sun) after 09/1645 UTC. Geomagnetic activity was Unsettled (Kp3) to start, before becoming Quiet from 09/0300 UTC, with a further Unsettled interval from 09/2100 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels throughout. High energy electron flux (greater than 2MeV) was at normal background levels throughout. Electron fluence remained well below the Active threshold (1e8 integrated pfu), with 1.53e6 integrated pfu recorded at 09/2359 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low or Very Low, with further C-class flares possible. In addition, there is an increasing daily Slight Chance of M-class flares, as several returning regions are expected to rotate onto the visible disc over the coming days.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs in the forecast. We currently have slightly-elevated wind speeds from CH43/-, which are expected to slowly ease through into Day 2 (11 Jan). Geomagnetic activity is likely to be Quiet to Unsettled, with a chance of Active intervals through Day 1 (10 Jan). The likelihood of further G1/Minor Storm intervals is now considered very low. Activity is then expected to be mainly Quiet through Days 2 to 4 (11-13 Jan).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is most likely to remain at background levels, albeit with a very slight increase in risk with the westward progression of the current front-sided sunspots.
The high energy electron flux (greater than 2MeV) is likely to increase through this period as the HSS from CH43 wanes. There is a Chance of Active fluence later in the four-day period after the initial suppression eases.

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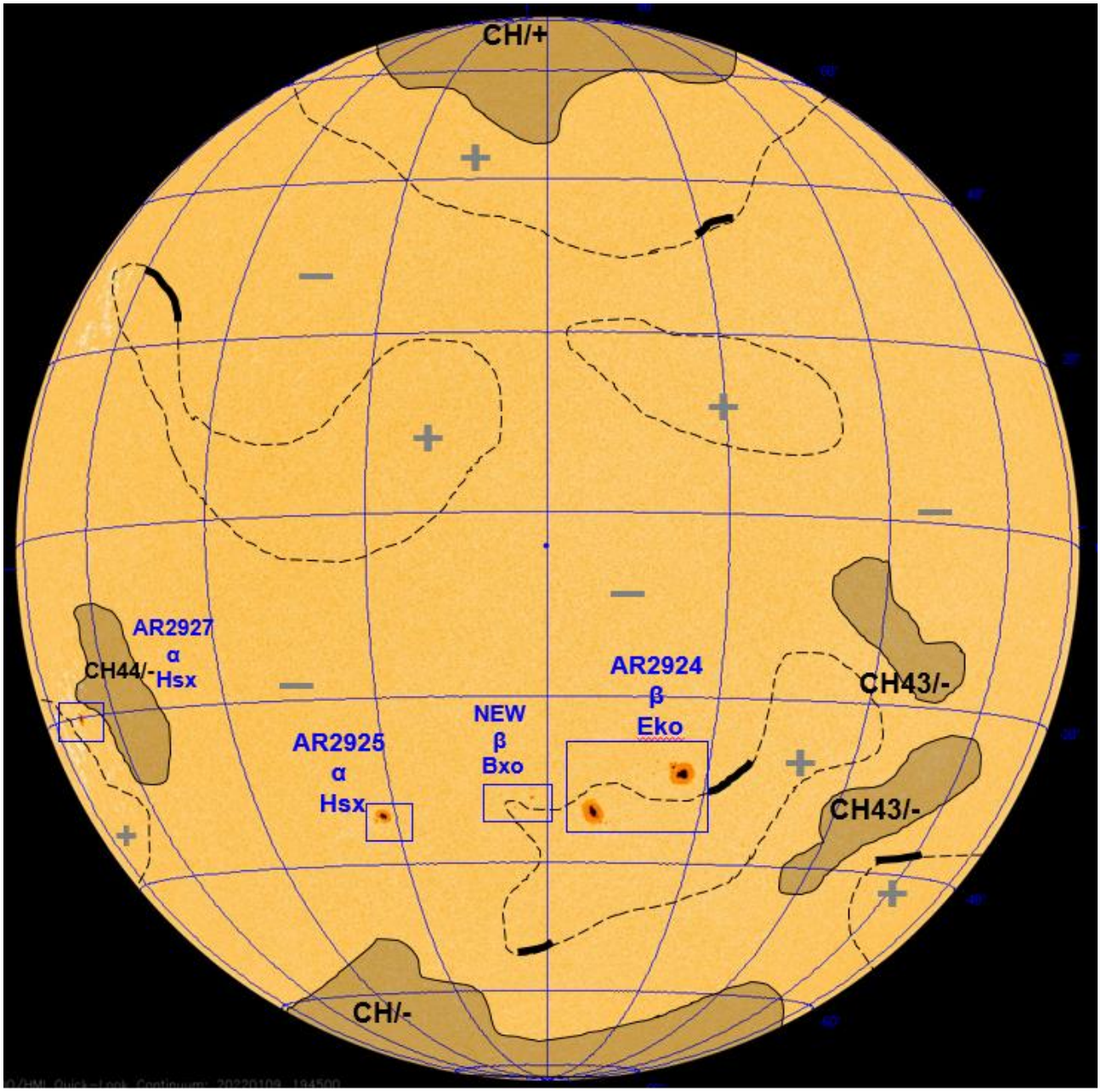
Figure 1. Solar Analysis Valid 09/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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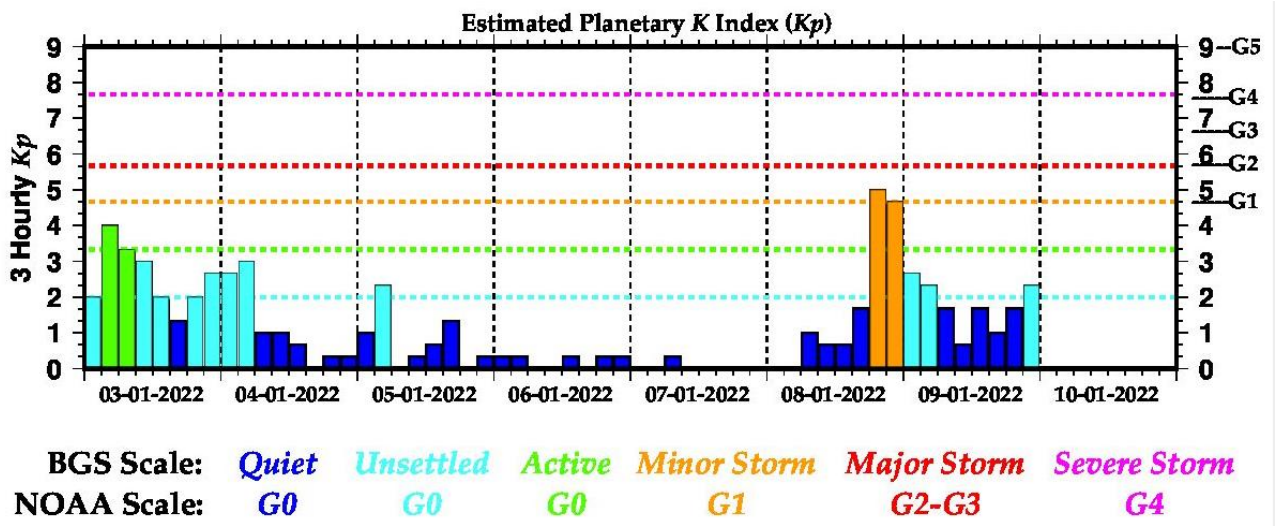
Geomagnetic Storms:

No Earth-directed CMEs feature in this forecast period.
The main feature of interest in this period is the non-recurrent coronal hole 43 in the southern solar hemisphere, we are now in the HSS with slightly-elevated wind speeds. It seems likely that wind speeds will remain slightly-elevated through the next 18-24 hours or so, before a gradual easing back to ambient levels during day 2 (11 Jan).
Geomagnetic activity is likely to be Quiet to Unsettled, with a chance of Active intervals through Day 1 (10 Jan). The likelihood of further G1/Minor Storm intervals is now considered very low. Activity is then expected to be mainly Quiet through Days 2 to 4 (11-13 Jan).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Kp. Quiet to Unsettled on the 9th.



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Radio Blackouts - X-Ray Flares:

Solar activity has remained Very Low in the last 24 hours. AR2924 is the most complex spot on the disc, and given this spot's complexity, the current lack of flaring is somewhat below expectations. However, there is some compensation expected as a result of several returning regions over the eastern solar horizon. Newly numbered AR2927 on the southeast limb is likely to be one of two returning regions Ex-2907 and 2908, both M-class flare-producing regions on previous rotation. However, it currently appears to be a small and simple region with little activity. There is also an area of plage rotating onto the northeast limb, this maybe Ex-2911, which also gave an isolated M-class flare on its last rotation across the visible disk. This area will be monitored for any development. The current lack of flaring and simplicity of the remaining regions means the x-ray flare risk has been reduced to 10% at the start of the period.
We are now starting to see numerous CMEs in coronagraph imagery from well over the eastern limb, likely associated with other previous active regions as they rotate around the far side. As such, the expected course of X-ray flux is upwards through the course of this week. The degree to which this occurs is uncertain, however a gradual slight increase in the risk of M-class flares is suggested until they present for analysis and more detail can be given.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	15	15	20
Very Active	R3 to R5 X Class	No	1	1	1	2

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at Background levels and will most likely persist at this level in the absence of solar activity. There is just a very slightly increasing chance of S1 as a result of westward progression of the current front sided sunspot groups.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	2	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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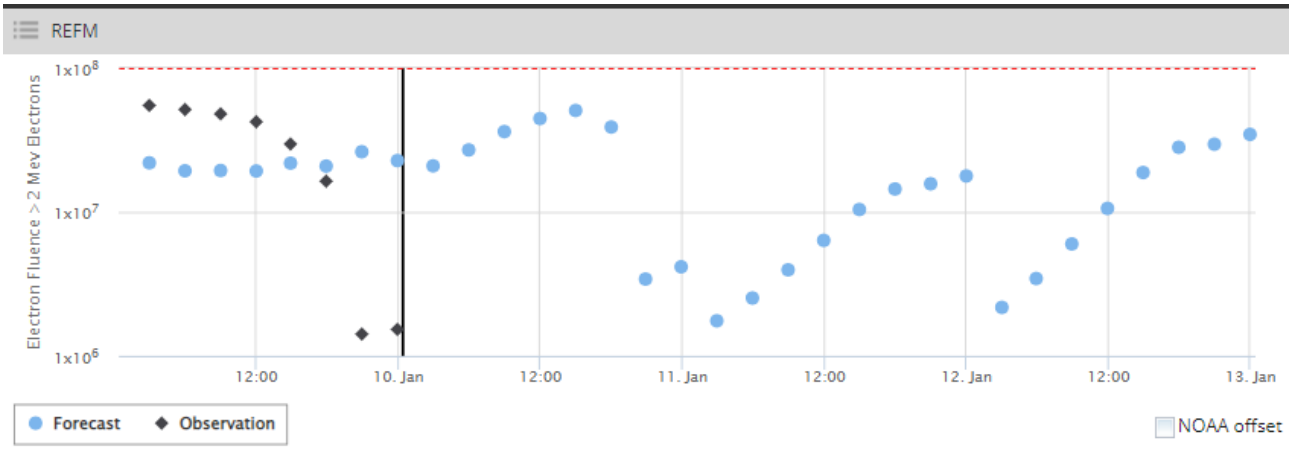
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been suppressed at Normal Background levels. This is likely to continue through Day 1 (10 Jan), then as the HSS wanes and the radiation belts de-compress, a rise is possible from Day 2 (11 Jan) onward. However, the level of charging likely to occur during this period is not certain. As such, peaks above the High threshold are possible from Day 2 onward, though confidence remains low.

The electron fluence will start well below the Active level (1e8 integrated pfu) on a declining trend. Then an increase is likely from Day 2 onwards, with a chance of reaching Active later in the period. Modelling available to MOSWOC is not felt likely to be particularly representative in the current set-up, given the non-persistent coronal hole that dominates the geomagnetic forecast. That said, REFM is starting to show a rising trend from day 2 (11 Jan), this is considered good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: While there is a REF model signal for an increasing trend from Day 2 (11 Jan) breaching the 1e8 Integrated pfu Active level remains unlikely.



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